tralian stations, to ascertain the weather conditions at any place in the waters surrounding the Pacific Islands, New Zealand, and Auatralia.

Primarily this service is given for the benefit of the vessels in these waters, but it is hoped that from the information reported daily to the meteorological stations in New Zealand valuable information and data may be compiled to assist in forecasting weather conditions throughout the South Pacific waters.—*Vice Consul John E. Moran, Wellington, New Zealand.*

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## SUBMARINE VOLCANO IN THE TONGA GROUP.

ANDREW THOMSON, Acting Director.

[Apia Observatory, Apia, Samoa, July 20, 1923.]

A submarine volcano was sighted on July 1 (eastern time) by Captain Davey, of the Union S. S. passenger liner *Tofua*, about 25 miles east of Tonga Tabu, the main island of the Tonga group.

The geographical position of the volcano was very closely 175° 33′ W., 20° 52′ S. When first sighted, the vapor from the volcano was taken to be the smoke of a passing steamer, but on nearer approach the density and great volume of steam made the true cause evident. The steam column rose to a height of 80 or 90 feet and trailed out like a banner over the ocean for a mile before becoming dissipated. At the level of the ocean the steam column was of the order of 100 feet in diameter. During the time the steam column was visible it remained fixed in size and position. There was marked turbulence and discoloration of the water at the point where the steam issued from the water. It was variously estimated that the water was shot up to a height from 2 to 4 feet above the sea.

The steam column was at the north end of a circular, pale-green area, about one-half mile in diameter. This area was sharply distinguished from the deep blue of the surrounding ocean. The charts give a depth of 550 fathoms for this locality. The volcano is well south of the position indicated on the charts for a volcano active in 1911, and is on the run of steamers from Suva to Nukualofa, the chief port of the Tonga group. There was no indication of volcanic activity when Captain Davey sailed over this position in 1920.

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## GROUND SURFACE TEMPERATURES AS DEPENDENT ON INSOLATION AND AS CONTROLLING DIURNAL TEMPERATURE UNREST AND GUSTINESS.[1]

By M. ROBITZCH.

[Abstracted from Beitrage zur Physik der freien Atmosphäre, 1921, 9: 1-11.]

From March to June, 1916, continuous observations of the difference in temperature between the surface and a depth of 1.25 m. were made with thermo-elements and a recording galvanometer, in sandy soil without vegetation. Simultaneous records of insolation were also obtained. The closeness of the relation between ground surface temperature and the insolation on a horizontal surface on a day with cumulus clouds is evident from Figure 1. For the general discussion the author chose six bright days in May and June and averaged the values. Figure 2 shows the intensity of insolation normal to the sun's rays and on a horizontal surface. The occurrence at 10 a. m. of the maximum intensity at normal incidence is readily explained as a result of the effect of cumulus clouds in cutting off sunlight intermittently during the following six hours. The diurnal course of insolation on

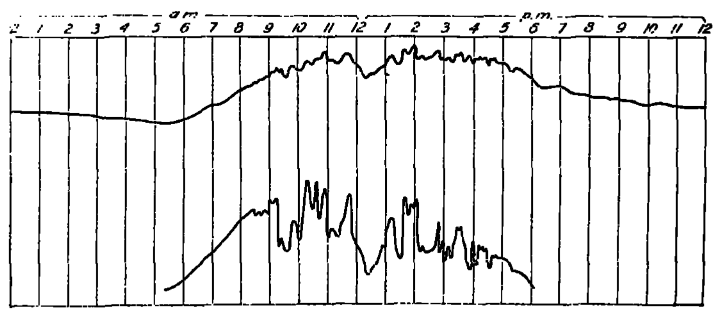


FIG. 1.—Relation between ground surface temperature (upper curve) and insolation on a horizontal surface (lower curve) on a day with cumulus clouds.

the horizontal surface of the ground, and the resulting surface temperature are shown in Figure 3, in which the ordinates have been so adjusted as to make the two curves

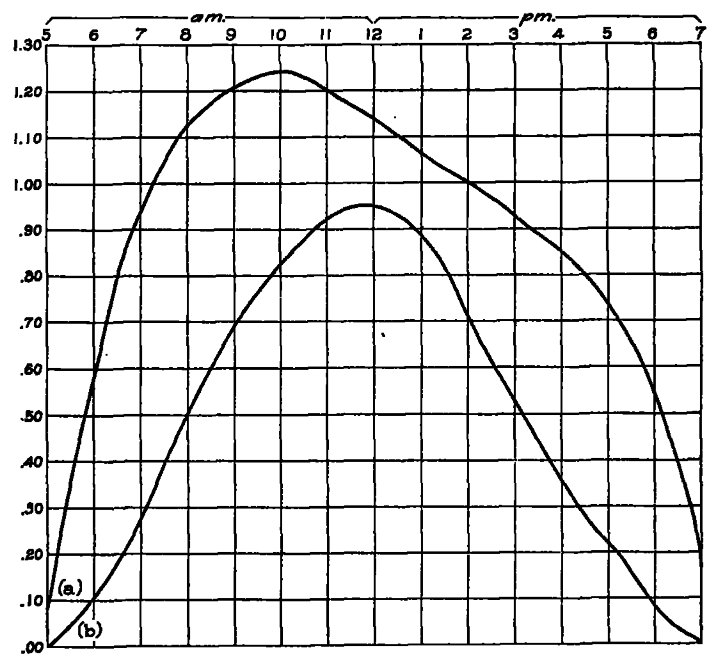


FIG. 2.—Intensity of insolation on a surface normal to the sun's rays (curve *a*) and on a horizontal surface (curve *b*).

cross at the minimum and maximum temperature, where insolation and outgoing radiation are equal. Thus the area ABCD equals CEAF, the former representing the

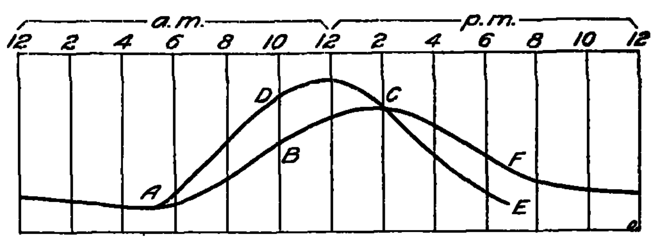


FIG. 3.—Diurnal course of insolation on a horizontal surface (curve *ADCE*) and resulting surface temperature (curve *ABCF*).

heat used in evaporating moisture from the ground and in warming the air, and the latter, the heat received by condensation and by return of heat from the air.

[1] Einige Bezeihungen zwischen der Temperature der Erdoberflache, der Insolation und anderen meteorologischen Faktoren.

As different surfaces of the ground heat very irregularly under strong insolation, in consequence of their diverse absorption and radiation coefficients, colors, characters of surface, specific heats, wetness, and conductivity, the immediately overlying air is correspondingly unevenly heated, the greatest differences being found with the most intense insolation. The movement of the air carries these irregularly heated masses past the thermometer, which records temperature unrest. Figure 4 shows the closeness with which this unrest corresponds to the intensity of insolation. The flattenings of the curve of temperature unrest just after

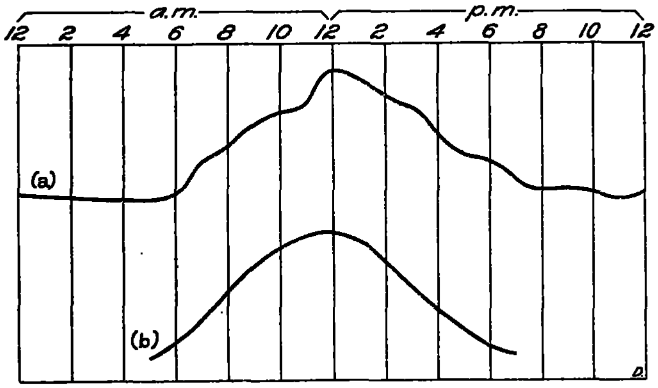


FIG. 4.—Curve of temperature unrest (a) and insolation (b).

10 a. m. and 5 p. m. correspond to the times of beginning and ending of active convection, which, thus, is seen to play a secondary rôle.

Gustiness of the ground wind depends directly on convection, which in turn is a function of the heating of the lower air by the ground. Thus it is not surprising to find the close relationship between gustiness and ground surface temperature shown in Figure 5. The minor irregularities in the gustiness as curve between about 8 a. m. and 2–3 p. m. have their approximate counterparts in the curve of temperature unrest. (Fig. 4.)

At the close of the paper, attention is directed to similarities sometimes found between depressions in the

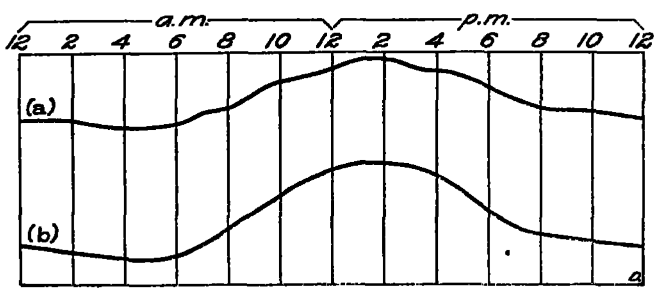


FIG. 5.—Curve of gustiness of the wind (a) and ground surface temperature (b).

rising and falling curves of the actionmeter on the same day. That is, depressions occur with the same angular height of the sun. These the author explains as the result of increased absorption or reflection at the top of an inversion layer. On March 12, 1919, there was an inversion of about 6° C. reaching to 300 m. and one of 1° C. at about 2,400 m.—*C. F. B.*

## UPPER-AIR OBSERVATIONS IN NORTH RUSSIA.

[Reprinted from *Nature* (London), Aug. 18, 1923, p. 248.]

A Professional Note, volume 3, No. 32, carried out by Mr. W. H. Pick, has been published on the above by the Meteorological Office, Air Ministry. The observations are based upon pilot-balloon ascents between February 25 and September 13, 1919, at three stations in northwest Russia. The stations are Murmansk, at the head of the Kola Creek, in latitude about 69° N., Archangel on the southwestern coast of the White Sea, in latitude 64° 33′ N., and Lumbushi on the Murman Railway, in latitude about 68° N. The ascents were all carried out with one theodolite only, the balloon being given a vertical lift of, theoretically, 500 feet per minute. The high latitude in which the observations were obtained renders them of value. There were at Murmansk 57 occasions on which the surface winds was in the north east wuadrant, and on 10 of these, that is, 17.5 per cent of the total, the wind backed continuously up to 2,000 feet. On the other hand, there were 164 occasions on which the surface wind was not in the northeast quadrant, and in only 5 of these; that is, 3 per cent of the whole, did the wind back continuously upward. At Murmansk three ascents reached to a height of 40,000 feet, where two of the winds were northwest and one southwest. Two ascents reached to 60,000 feet, where both winds were southwest. Seven ascents reached 20,000 feet, at that height four of the winds were southwest and two northwest. Of the ascents carried out at Archangel only one reached 20,000 feet, where the wind was southerly. Of the ascents at Lumbushi, six attained a height of 20,000 feet, giving two northwesterly winds, three northeasterly, and one southerly.

## WHY ARE TYPHOONS IN CHINA SEA MORE FREQUENT THAN WEST INDIAN HURRICANES?

A correspondent of the Weather Bureau raises the above question. The reply by the Chief of Weather Bureau will doubtless be of interest to REVIEW readers and is accordingly reproduced below:

It is a definitely known fact that tropical cyclones have their origin within the region of calms of the Tropics, commonly known as the doldrums, and that cyclones form in this belt of calms only when it lies at an appreciable distance from the Equator. Now if nothing more than still, or relatively still, moist, warm air were essential to the formation of a cylcone of the Tropics then one would expect to find several in operation at the same time when this belt of calms lies say ten or more degrees either north or south of the Equator. But this does not follow, for it is our experience that the major part of a cyclone season may pass without the semblance of a hurricane, and rarely, if ever, do we note more than one cyclone at any one time in the West Indies. The foregoing being accepted as true, we must then seek a contributory cause of the formation of a cyclone outside the still, moist, warm air of the doldrums. Now, if we consider the seeming fact that the loci of tropical cyclonic formations on the North Atlantic are two in number, one the Western Caribbean Sea and the other the region about the Cape Verde Islands, where the belt of calms is at times flanked by oppositely directed systems of winds, one of which is the northeast trade of our hemisphere and the other the similar trade wind of the southern hemisphere, which after having crossed the Equator comes under the right-hand deflective influence of the earth's rotation, and is changed to a southwest wind system, it is reasonable to assume that these passing wind systems have perhaps much to do with the formation of tropical cyclones. Over the North Atlantic, within the Tropics, it is probably true that this contributory cause is rarely in operation, whereas in the East Indies the southwest monsoon blows during much of the cyclone season and on approaching, but passing to the south of the northeast trade wind system of the North Pacific Ocean, there naturally arise many occasions when the conditions are what may be regarded as ideal for the development of cyclones. Hence the greater frequency of the typhoon. Of course the deflective influence of the earth's rotation plays an important part in the changing of the course of these two primary wind systems (each one being turned to the right), and by doing so lowers the barometric pressure over the intervening region and in addition thereto determines the direction of rotation of the winds of the cyclone itself. Now, if these primary wind systems initiate an incipient whirl, then the condensation of water vapor, and the consequent setting free of latent heat, immediately gives the energy that maintains the cyclone during days and at times weeks. Otherwise, it seems likely the life of the cyclone would be very short.